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Epitome

(57) [Abstract]
[Technical problem] The air conditioner which can improve refrigerating capacity conventionally is offered.
[Means for Solution] It has the refrigerant circuit 1 where a refrigerant flows in order of a compressor 2, a condenser 3, the heat exchanger 10 for supercooling, the 1st expansion device 4, and an evaporator 5. A non-azeotropy mixing refrigerant is used as a refrigerant. A refrigerant circuit 1 has the 2nd expansion device 12 in this bypass circuit 13 while being equipped with the bypass circuit 13 which branches from a main circuit 6 between a condenser 3 and the 1st expansion device 4, and joins a main circuit 6 by the inlet side of a compressor 2. The heat exchanger 10 for supercooling performs heat exchange between the mainstream refrigerant which flows a main circuit 6, and the bypass style refrigerant which flows the bypass circuit 13 after the 2nd expansion device 12 passage. The heat exchanger 10 for supercooling is a counterflow mold heat exchanger to which the above-mentioned mainstream refrigerant and the above-mentioned bypass style refrigerant flow to the opposite sense mutually on both sides of wall 10a with heat-conducting characteristic.

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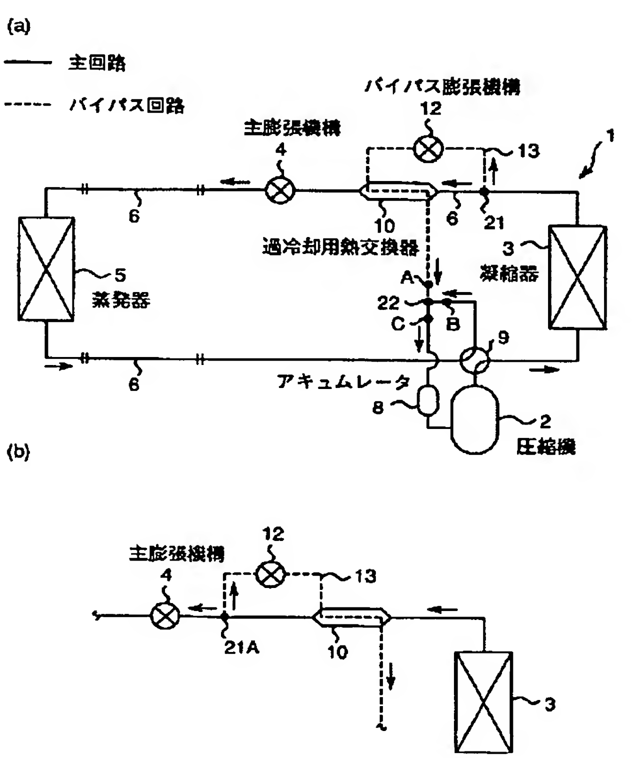

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CLAIMS

[Claim(s)]
[Claim 1] In the air conditioner equipped with the refrigerant circuit (1) where a refrigerant flows in order of a compressor (2), a condenser (3), the heat exchanger for supercooling (10), the 1st expansion device (4), and an evaporator (5) A non-azeotropy mixing refrigerant is used as the above-mentioned refrigerant. The above-mentioned refrigerant circuit (1) While having the bypass circuit (13) which branches from a main circuit (6) between the above-mentioned condenser (3) and the 1st expansion device (4), and joins the above-mentioned main circuit (6) by the inlet side of the above-mentioned compressor (2) It has the 2nd expansion device (12) in this bypass circuit (13). The above-mentioned heat exchanger for supercooling (10) Heat exchange is performed between the mainstream refrigerant which flows the above-mentioned main circuit (6), and the bypass style refrigerant which flows the above-mentioned bypass circuit after expansion device (12) passage of the above 2nd (13). The above-mentioned heat exchanger for supercooling (10) is an air conditioner characterized by being the counterflow mold heat exchanger to which the above-mentioned mainstream refrigerant and the above-mentioned bypass style refrigerant flow to the opposite sense mutually on both sides of a wall (10a) with heat-conducting characteristic.
[Claim 2] It is the air conditioner characterized by the above-mentioned bypass circuit (13) having branched from the above-mentioned main circuit (6) between the above-mentioned condenser (3) and the heat exchanger for supercooling (10) in an air conditioner according to claim 1.
[Claim 3] It is the air conditioner characterized by the above-mentioned bypass circuit (13) having branched from the above-mentioned main circuit (6) in an air conditioner according to claim 1 between the above-mentioned heat exchanger for supercooling (10), and the 1st expansion device (4).

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to an air conditioner. It is related with the air conditioner equipped with the refrigerant circuit which circulates a refrigerant in more detail in order of a compressor, a condenser, the heat exchanger for supercooling that supercools a refrigerant, an expansion device, and an evaporator.

[0002]
[Description of the Prior Art] As s[redacted] in drawing 10 , as a refrigerant circu[redacted]1 of this kind of air conditioner The main circuit 306 which has a compressor 302, a condenser 303, the double pipe exchanger 310 for supercooling, the main expansion device 304, an evaporator 305, the 4 way change-over valve 309, and an accumulator 308 in this order, It branches from a main circuit 306 at the branch point 321 between the above-mentioned condenser 303 and a double pipe exchanger 310. It passes along the bypass expansion device 312 and a double pipe exchanger 310, and the thing including the bypass circuit (a broken line shows) 313 which joins a main circuit 306 in the juncture 322 near the inlet port of the above-mentioned accumulator 308 is known. Conventionally, the single refrigerant of HCFC(hydrochlorofluorocarbon)22 grade is used as a refrigerant. The refrigerant breathed out from the compressor 302 is condensed by the condenser (for example, heat is radiated to outdoor air) 303, and separates to the mainstream refrigerant which flows a main circuit 306 at a junction 321, and the bypass style refrigerant which flows the bypass circuit 313. In a double pipe exchanger 310, after this mainstream refrigerant is supercooled by heat exchange with the above-mentioned bypass style refrigerant after bypass expansion device 312 passage, it is decompressed by the main expansion device 304. And a mainstream refrigerant evaporates with an evaporator (for example, it carries out endoergic from indoor air) 305, and is absorbed by the compressor 302 through the accumulator 308 which performs the 4 way change-over valve 309 and vapor liquid separation. On the other hand, after a bypass style refrigerant passes the above-mentioned bypass expansion device 312 and is decompressed, it evaporates by heat exchange with a mainstream refrigerant in a double pipe exchanger 310. Then, a bypass style refrigerant joins a mainstream refrigerant in the juncture 322 near the inlet port of an accumulator 308.
[0003] Thus, by supercooling a mainstream refrigerant by the double pipe exchanger 310, the refrigerating effect by the mainstream refrigerant can be increased as compared with the case where supercooling is not performed. Moreover, since the volumetric flow rate of a mainstream refrigerant decreases by branching a bypass style from the flow of a refrigerant, as shown in the pressure-specific-enthalpy diagram (henceforth "Ph diagram") of drawing 11 (b), pressure loss deltaP in the inside of an evaporator 305 and inlet-side piping of a compressor 302 can be decreased (since it is a comparison, the pressure loss deltaP0 when not performing supercooling is shown in drawing 11 (a).). Therefore, the refrigerating capacity of a system can be raised. In addition, the part shown by A, B, and C in drawing 11 (b) supports the condition of the about 322 juncture [ in the refrigerant circuit 301 of drawing 10 ] points A, B, and C. The bypass style refrigerant which reached Point A, and the mainstream refrigerant which reached Point B join, and the condition of Point C is acquired so that drawing 11 (c) which expands drawing 11 (b) partially and shows it may show well. [0004]
[Problem(s) to be Solved by the Invention] By the way, always raising the refrigerating capacity of an air conditioner is called for, and there are no limits in the demand of a refrigerating capacity rise.
[0005] Then, the purpose of this invention is to offer the air conditioner which can raise refrigerating capacity further rather than before.
[0006]
[Means for Solving the Problem] In order to attain the above-mentioned purpose, an air conditioner according to claim 1 In the air conditioner equipped with the refrigerant circuit where a refrigerant flows in order of a compressor, a condenser, the heat exchanger for supercooling, the 1st expansion device, and an evaporator A non-azeotropy mixing refrigerant is used as the above-mentioned refrigerant. The above-mentioned refrigerant circuit While having the bypass circuit which branches from a main circuit between the above-mentioned condenser and the 1st expansion device, and joins the above-mentioned main circuit by the inlet side of the above-mentioned compressor It has the 2nd expansion device in this bypass circuit. The above-mentioned heat exchanger for supercooling Heat exchange is performed between the mainstream refrigerant which flows the above-mentioned main circuit, and the bypass style refrigerant which flows the above-mentioned bypass circuit after expansion device passage of the above 2nd. The above-mentioned heat exchanger for supercooling It is characterized by being the counterflow mold heat exchanger to which the above-mentioned mainstream refrigerant and the above-mentioned bypass style refrigerant flow to the opposite sense mutually on both sides of a wall with heat-conducting characteristic.
[0007] It sets in Ph diagram which expresses the condition of a refrigerant with the air conditioner of this claim 1 since the boiling points of the refrigerant which constitutes a non-azeotropy mixing refrigerant differ mutually, and is inclination (inclination to a specific-enthalpy shaft.) to the constant-temperature line in a two phase region (wet steam range). It is called a "temperature gradient" below. It is generated. For the temperature gradient of this two phase region, the inlet temperature of an evaporator falls as compared with the case where a single refrigerant is used. Therefore, with an evaporator, the temperature gradient between the fluid (for example, indoor air) by which endoergic is carried out, and the above-mentioned refrigerant passing through the inside of the evaporator becomes large, and the heat exchange capacity of an evaporator

increases. Consequently, the refrigerating capacity improvement effect by supercooling improves further by heat exchange capacity increase o[illegible] above-mentioned evaporator as co[illegible]ed with the case where a single refrigerant is used.

[0008] Moreover, in this air conditioner, using the bypass style refrigerant after expansion device passage of the above 2nd, a mainstream refrigerant can be supercooled as easy circuitry is also.

[0009] Furthermore, in this air conditioner, since the above-mentioned heat exchanger for supercooling is a counterflow mold heat exchanger, the mean temperature difference between the mainstream refrigerants and bypass style refrigerants which are a non-azeotropy refrigerant in the both sides of a wall with the heat-conducting characteristic of the heat exchanger for supercooling becomes comparatively large. For example, it becomes larger than the mean temperature difference in the case of a parallel-current-flow mold heat exchanger. Consequently, the capacity of the heat exchanger for supercooling improves.

[0010] An air conditioner according to claim 2 is characterized by the above-mentioned bypass circuit having branched from the above-mentioned main circuit between the above-mentioned condenser and the heat exchanger for supercooling in an air conditioner according to claim 1.

[0011] Since the object supercooled by the heat exchanger for supercooling serves as only a mainstream refrigerant, the size of the heat exchanger for supercooling is comparatively small, and can be managed with the air conditioner of this claim 2.

[0012] An air conditioner according to claim 3 is characterized by the above-mentioned bypass circuit having branched from the above-mentioned main circuit between the above-mentioned heat exchanger for supercooling, and the 1st expansion device in an air conditioner according to claim 1.

[0013] In the air conditioner of this claim 3, since the bypass style refrigerant which branched from the mainstream refrigerant after the heat-exchanger passage for supercooling goes into the 2nd expansion device, possibility that two-phases flow will enter decreases in the 2nd expansion device. Therefore, the 2nd expansion device does not have a possibility of causing hunting, and operates to stability.

[0014]

[Embodiment of the Invention] Hereafter, the gestalt of implementation of this invention is explained to a detail.

[0015] (The 1st operation gestalt) As shown in drawing 1 (a), the air conditioner of 1 operation gestalt of this invention is equipped with the refrigerant circuit 1 including a main circuit 6 and the bypass circuit (a broken line shows) 13. As a refrigerant made to circulate through a refrigerant circuit 1, the non-azeotropy mixing refrigerant which consists of R-32/134a or R-407C is used.

[0016] The main circuit 6 has the main expansion device 4, the evaporator 5, the 4 way change-over valve 9, and accumulator 8 as a compressor 2, a condenser 3, the double pipe exchanger 10 as a heat exchanger for supercooling, and 1st expansion device in this order. The bypass circuit 13 branches from a main circuit 6 at the junction 21 between a condenser 3 and a double pipe exchanger 10, passes along the bypass expansion device 12 and double pipe exchanger 10 as 2nd expansion device, and joins the main circuit 6 in the juncture 22 near the inlet port of an accumulator 8. A double pipe exchanger 10 performs heat exchange between the mainstream refrigerant which flows a main circuit 6, and the bypass style refrigerant which flows the above-mentioned bypass circuit 13 after bypass expansion device 12 passage. That is, using the bypass style refrigerant after bypass expansion device 12 passage, a mainstream refrigerant is supercooled as easy circuitry is also. In detail, the double pipe exchanger 10 has inner-tube 10a and outer-tube 10b prepared in the outside of this inner-tube 10a in the shape of a concentric circle, as typically shown in drawing 4 (a). The sense which pours a refrigerant is set up so that the mainstream refrigerant which flows annular clearance 10c between the bypass style refrigerant which flows the inside of inner-tube 10a, and inner-tube 10a and outer-tube 10b may flow to the opposite sense mutually on both sides of the tube wall with heat-conducting characteristic of inner-tube 10a (counterflow mold heat exchanger). Thus, when a heat exchanger 10 is used as a counterflow mold, as shown in drawing 4 (b), the mean temperature difference about the flow direction between the mainstream refrigerants and bypass style refrigerants with heat-conducting characteristic in the both sides of the tube wall of inner-tube 10a becomes comparatively large. For example, it becomes larger than the mean temperature difference in the case of the parallel-current-flow mold heat exchanger shown in drawing 4 (c). Consequently, the capacity of a heat exchanger 10 can be raised.

[0017] Now, the refrigerant breathed out from the compressor 2 shown in drawing 1 (a) is condensed by the condenser (for example, heat is radiated to outdoor air) 3, and separates to the mainstream refrigerant which flows a main circuit 6 at a junction 21, and the bypass style refrigerant which flows the bypass circuit 13. In a heat exchanger 10, after this mainstream refrigerant is supercooled by heat exchange with the above-mentioned bypass style refrigerant after bypass expansion device 12 passage, it is decompressed by the main expansion device 4. And a mainstream refrigerant evaporates with an evaporator (for example, it carries out

endoergic from indoor air) 5, and is absorbed by the compressor 2 through the accumulator 8 which performs the 4 way change-over valve 9 and [illegible]or liquid separation. On the other hand, after a bypass style refrigerant passes the bypass expansion device 12 and is decompressed, it evaporates by heat exchange with a mainstream refrigerant in a heat exchanger 10. Then, a bypass style refrigerant joins a mainstream refrigerant in the juncture 22 near the inlet port of an accumulator 8.

[0018] Thus, by supercooling a mainstream refrigerant by the heat exchanger 10, the refrigerating effect by the mainstream refrigerant can be increased as compared with the case where supercooling is not performed. Moreover, as compared with the case (refer to drawing 11 (a)) where supercooling is not performed, since the volumetric flow rate of a mainstream refrigerant decreases by branching a bypass style from the flow of a refrigerant, as shown in the pressure-specific-enthalpy diagram (henceforth "Ph diagram") of drawing 2 , pressure loss deltaP in the inside of an evaporator 5 and inlet-side piping of a compressor 2 can be decreased. Therefore, the refrigerating capacity of a system can be raised. In addition, the part shown by A, B, and C in drawing 2 supports the condition of the about 22 juncture [ in the refrigerant circuit 1 of drawing 1 (a) ] points A, B, and C.

[0019] And it sets in Ph diagram shown in drawing 2 since the boiling points of the refrigerant which constitutes the non-azeotropy mixing refrigerant which flows a refrigerant circuit 1 differ mutually, and is inclination (inclination to a specific-enthalpy shaft.) to the constant-temperature line in a two phase region (wet steam range). It is called a "temperature gradient" below. It is generated. For the temperature gradient of this two phase region, the inlet temperature of an evaporator 5 falls as compared with the case where a single refrigerant is used. Therefore, with an evaporator 5, the temperature gradient between the fluid (for example, indoor air along which it passes in contact with the fin of an evaporator) by which endoergic is carried out, and the refrigerant passing through the inside of the evaporator 5 becomes large, and the heat exchange capacity of an evaporator 5 increases. For example, if the inlet temperature of an evaporator 5 falls only in 2 deg as shown in drawing 3 , the heat exchange capacity of an evaporator 5 will increase about 15%. Consequently, the refrigerating capacity improvement effect by supercooling can be further raised by heat exchange capacity increase of an evaporator 5 as compared with the case where a single refrigerant is used.

[0020] Moreover, since the bypass circuit 13 has branched from a main circuit 6 between a condenser 3 and a heat exchanger 10 as shown in drawing 1 (a), the object supercooled by the heat exchanger 10 serves as only a mainstream refrigerant. Therefore, size of a heat exchanger 10 can be made comparatively small.

[0021] In addition, you may make it the bypass circuit 13 branch from a main circuit 6 between a heat exchanger 10 and the main expansion device 4 (branch point 21A), as shown in drawing 1 (b). Since the bypass style refrigerant which branched from the mainstream refrigerant after passing a heat exchanger 10 goes into the bypass expansion device 12 when it does in this way, possibility that two-phases flow will enter decreases in the bypass expansion device 12. Therefore, the bypass expansion device 12 does not have a possibility of causing hunting, and operates to stability.

[0022] As mentioned above, the heat exchanger 10 is performing heat exchange between the mainstream refrigerant which flows the main circuit 6 in the condition of having been condensed by the condenser 3, and the bypass style refrigerant after bypass expansion device 12 passage. That is, fundamentally, the heat exchanger 10 is operating as a liquid-solution temperature exchanger which performs heat exchange between the mainstream refrigerant after condenser 3 passage and before evaporator 5 passage, and a bypass style refrigerant. On the other hand, as shown in drawing 5 , in order to supercool the mainstream refrigerant after condenser 5 passage, the mainstream refrigerant of the gaseous phase after evaporator 5 passage (compressor inlet side) may be used, and a heat exchanger 10 may be operated as a mind-solution temperature exchanger. However, when operating the heat exchanger 10 as shown in drawing 1 as a liquid-solution temperature exchanger, as shown in Ph diagram of drawing 7 (a), it originates in the temperature gradient in a two phase region, and mean temperature difference deltaTm about the flow direction in a heat exchanger 10 becomes larger than deltaTm in the case of making it operate as a mind-solution temperature exchanger (shown in drawing 7 (b)). Therefore, size of a heat exchanger 10 can be made comparatively small, and fault (refer to drawing 6 ) to which the degree of superheat of the inlet side of a compressor 2 becomes large does not arise. Consequently, the refrigerating capacity improvement effect by using a non-azeotropy mixing refrigerant can be demonstrated more effectively.

[0023] (The 2nd operation gestalt) Drawing 8 shows the air conditioner of another operation gestalt equipped with the refrigerant circuit 101 which supercools a refrigerant using the cold energy stored in ice. This refrigerant circuit 101 is equipped with the refrigerant circuit 101 including a main circuit 106 and a short circuit 113. As a refrigerant made to circulate through a refrigerant circuit 101, the non-azeotropy mixing refrigerant which consists of R-32/134a or R-407C is used.

[0024] The main circuit 106 has the receiver 107 for storing a compressor 102, the outdoor heat exchanger

103 as a condenser, and a refrigerant temporarily, the 2nd electronic expansion valve 112, the 1st electronic expansion valve 104 as 1st expansion device, the indoor heat exchanger 105 as an evaporator, and an accumulator 108 in this order. Outdoor side connection edge 110b of the heat exchanger 110 for accumulation as a heat exchanger for supercooling and interior-of-a-room side connection edge 110c are connected to juxtaposition at the 2nd electronic expansion valve 112. In the heat storage tank 109 which filled the water W as an accumulation medium, the heat exchanger 110 for accumulation prepares cooling pipe 10a which moves in a zigzag direction in the direction of a vertical, and is formed. The 1st closing motion valve 111 is inserted in piping between the body 109 of the heat exchanger 110 for accumulation, and outdoor side connection edge 110b. A short circuit 113 branches from between the body 109 of the heat exchanger 110 for accumulation, and the 1st closing motion valves 111, and joins the main circuit 106 near the inlet port of an accumulator 8. The 2nd closing motion valve 114 is inserted in this short circuit 113. The opening of closing motion of the 1st closing motion valve 111 and the 2nd closing motion valve 114, the 1st electronic expansion valve 104, and the 2nd electronic expansion valve 112 is controlled by the closing motion control means 116 according to the signal from the operational status of this air conditioner and each thermistors Th1 and Th2, and a pressure sensor Ps.

[0025] At the time of accumulation operation, while the closing motion control means 116 changes [ the 1st closing motion valve 111 ] an open condition and the 1st electronic expansion valve 104 into a close-by-pass-bulb-completely condition for a closed state and the 2nd closing motion valve 114, the opening of the 2nd electronic expansion valve 112 is controlled by it according to the signal from a thermistor Th 1 and a pressure sensor Ps. this -- the time -- a compressor -- 102 -- from -- breathing out -- having had -- a refrigerant (the arrow head of a continuous line shows the flow direction in drawing 8 ) -- an outdoor heat exchanger -- 103 -- condensing -- having -- a receiver -- 107 -- the -- two -- an electron -- an expansion valve -- 112 -- a passage -- accumulation -- ** -- a heat exchanger -- 110 -- setting -- the above -- water -- W -- heat exchange -- evaporating -- having had -- after -- a short circuit -- 113 -- the -- two -- closing motion -- a valve -- 114 -- a passage -- a main circuit -- 106 -- an accumulator -- eight -- letting it pass -- a compressor -- two -- absorbing -- having . It is cooled by heat exchange with the refrigerant which passes along cooling pipe 110a, and the water W in a heat storage tank 109 adheres to the front face of cooling pipe 110a as ice. Thereby, cold energy is stored in a heat storage tank 109.

[0026] At the time of air conditioning operation which performs accumulation recovery, the opening of a closed state, the 1st electronic expansion valve 104, and the 2nd electronic expansion valve 112 is controlled [ the 1st closing motion valve 111 ] for an open condition and the 2nd closing motion valve 114 by the closing motion control means 116 according to the signal from a thermistor Th 2 and a pressure sensor Ps. At this time, the refrigerant (the arrow head of a broken line shows the flow direction in drawing 8 ) breathed out from the compressor 102 is condensed by the outdoor heat exchanger 103, and passes along a receiver 107. then, some refrigerants -- the 2nd electronic expansion valve 112 -- a passage -- as it is -- juncture 110c -- reaching -- although -- the remaining refrigerants -- branch point 110b to the 1st closing motion valve 111 -- a passage -- the object for accumulation -- after heat exchange with the ice generated in heat exchanger 110 at the time of accumulation operation supercools, juncture 110c is reached. At this time, the flow rate of the refrigerant which passes along the 2nd electronic expansion valve 112, and the refrigerant which passes along the heat exchanger 110 for accumulation becomes settled by the opening of the 2nd electronic expansion valve 112. Since the heat exchanger 110 for accumulation supercools the above-mentioned refrigerant using the cold energy stored in ice, it can supercool effectively the refrigerant which passes along cooling pipe 110a. After the refrigerant which joined by juncture 110c is decompressed by the 1st electronic expansion valve 104, it evaporates by heat exchange with indoor air in indoor heat exchanger 105, and is absorbed by the compressor 2 through an accumulator 8.

[0027] Thus, by supercooling a refrigerant by the heat exchanger 110 for accumulation, a refrigerating effect can be increased as compared with the case where supercooling is not performed. And it sets in Ph diagram shown in drawing 2 since the boiling points of the refrigerant which constitutes the non-azeotropy mixing refrigerant which flows into indoor heat exchanger 105 differed mutually, and is inclination (inclination to a specific-enthalpy shaft.) to the constant-temperature line in a two phase region (wet steam range). It is called a "temperature gradient" below. It is generated. For the temperature gradient of this two phase region, the inlet temperature of indoor heat exchanger 105 falls as compared with the case where a single refrigerant is used. Therefore, by indoor heat exchanger 105, the temperature gradient between the indoor air by which endoergic is carried out, and the refrigerant passing through the inside of the indoor heat exchanger 105 becomes large, and the heat exchange capacity of indoor heat exchanger 105 increases. Consequently, the refrigerating capacity improvement effect by supercooling can be further raised by heat exchange capacity increase of indoor heat exchanger 105 as compared with the case where a single refrigerant is used.

[0028] In addition, what is necessary is to change the 1st closing motion valve 111 and the 2nd closing motion valve 114 into a closed state, to change the 2nd electronic expansion valve 112 into a full open condition, and just to control the opening of the 1st electronic expansion valve 104 by the closing motion control means 116 according to the signal from a thermistor Th 2 and a pressure sensor Ps, in order to perform the usual air conditioning operation which does not perform accumulation recovery. At this time, the refrigerant breathed out from the compressor 102 is condensed by the outdoor heat exchanger 103, passes along a receiver 107 and the 2nd electronic expansion valve 112, evaporates by indoor heat exchanger 105, and is absorbed by the compressor 102 through an accumulator 108.

[0029] (The 3rd operation gestalt) Drawing 9 shows the air conditioner of another operation gestalt equipped with the refrigerant circuit which supercools a refrigerant using the cold energy supplied from another refrigerant circuit.

[0030] This air conditioner is equipped with two sets of two sets of one set [ of an outdoor unit ] A containing two equipments H and I of the same configuration, and the indoor units B and C connected to one equipment H of this outdoor unit A, and the indoor units D and E connected to the equipment I of another side of indoor unit A.

[0031] One equipment H of outdoor unit A connects the expansion device 204 for heating operation connected to juxtaposition to an accumulator 208, the compressor 201 driven with an inverter 207, the 4 way change-over valve 202, an outdoor heat exchanger 203, the heat exchanger 225 for supercooling, the check valve 209 that makes only an one direction (sense shown by the arrow head of a continuous line all over drawing) pass a refrigerant at the time of air conditioning operation, and this check valve 209 for the refrigerant piping 205. Similarly, the equipment I of another side connects the expansion device 204 for heating operation connected to juxtaposition to an accumulator 208, the compressor 201 driven with an inverter 207, the 4 way change-over valve 202, an outdoor heat exchanger 203, heat exchanger 225B for supercooling, the check valve 209 that makes only an one direction pass a refrigerant at the time of air conditioning operation, and this check valve 209 for the refrigerant piping 205. Each indoor units B, C, D, and E are the same internal configurations, and connect the expansion device 211 for air conditioning operation connected to juxtaposition to indoor heat exchanger 210, the check valve 213 to which the time of air conditioning operation makes only hard flow pass a refrigerant at the time of heating operation, and this check valve 213 for the refrigerant piping 212, respectively. In addition, below, air conditioning operation shall be explained.

[0032] The indoor units B and C of each other being connected to juxtaposition for the refrigerant piping 215,215, other refrigerant piping 216,216 connects with one equipment H of outdoor unit A possible [ circulation of a refrigerant ], and one refrigerant circuit 217 is formed. Similarly, the indoor units C and D of each other being connected to juxtaposition for the refrigerant piping 218,218, other refrigerant piping 219,219 connects with the equipment I of another side of outdoor unit A possible [ circulation of a refrigerant ], and another refrigerant circuit 220 is formed. The pressure sensor 235,236 for detecting the operational status of the refrigerant circuit, respectively is formed in the inlet side (the near refrigerant inlet port of outdoor unit A) of the compressor 201 of each refrigerant circuit 217,220.

[0033] As a refrigerant made to circulate through these refrigerant circuits 217,220, the non-azeotropy mixing refrigerant which consists of R-32/134a or R-407C is used.

[0034] Bypass circuit 230,230B is prepared between the refrigerant circuit 217 by the side of Equipment H, and the refrigerant circuit 220 by the side of Equipment I. the bypass circuit 230 (it has the refrigerant piping 227,228) -- from the downstream (an outlet near [ at the time of air conditioning operation ]) of the outdoor heat exchanger 203 of a refrigerant circuit 220 -- branching -- the closing motion valve 231, the expansion device 226, and the heat exchanger 225 for supercooling of a refrigerant circuit 217 -- a passage -- a refrigerant circuit 220 -- the refrigerant circuit 220 is joined near the inlet port of an accumulator 208. bypass circuit 230B (it has the refrigerant piping 227B and 228B) -- from the downstream (an outlet near [ at the time of air conditioning operation ]) of the outdoor heat exchanger 203 of a refrigerant circuit 217 -- branching -- closing motion valve 231B, expansion device 226B, and heat exchanger 225B for supercooling of a refrigerant circuit 220 -- a passage -- a refrigerant circuit 217 -- the refrigerant circuit 217 is joined near the inlet port of an accumulator 208. It is constituted like the double pipe exchanger 10 shown in drawing 4 (a), and the heat exchanger 225 for supercooling performs heat exchange between the mainstream refrigerant which flows a refrigerant circuit 217, and the bypass style refrigerant which flows the bypass circuit 230 which branched from the refrigerant circuit 220. On the other hand, supercooling heat exchanger 225B performs heat exchange between the mainstream refrigerant which flows a refrigerant circuit 220, and the bypass style refrigerant which flows bypass circuit 230B which branched from the refrigerant circuit 217.

[0035] The closing motion valves 231 and 231B of bypass circuit 230,230B are made a closed state by the control means which is not illustrated at the time of the usual air conditioning operation which does not

perform supercooling. At this time, a refrigerant circuit 217 and a refrigerant circuit 220 perform air conditioning operation mutually-independent. For example, the refrigerant (the arrow head of a continuous line shows the flow direction in drawing 9 ) breathed out from the compressor 201 in the refrigerant circuit 220 is ****** about heat exchanger 225B in the condition of the outdoor heat exchanger 203 which works as a condenser condensing, and not performing heat exchange, and a check valve 209. Then, the expansion device 211 of each indoor units B and C decompresses, and it evaporates by the indoor heat exchanger 210 which works as an evaporator, and a compressor 201 absorbs through the accumulator 208 of outdoor unit A. This is the same also in a refrigerant circuit 217.

[0036] While the refrigerant circuit 217,220 is performing air conditioning operation independently, based on the output of a pressure sensor 235,236, a complementary gets down by the refrigerant circuit 217 side, and cold energy presupposes that it was judged that cold energy ran short by the refrigerant circuit 220 side. According to this decision result, by the control means, closed state and closing motion valve 231B is set as an open condition, and the closing motion valve 231 shifts to air conditioning operation to which a refrigerant circuit 220 carries out supercooling. At this time, some refrigerants which flow a refrigerant circuit 217 branch, and bypass circuit 230B is flowed as a bypass style refrigerant (the arrow head of a broken line shows the flow direction in drawing 9 ). Consequently, heat-exchanger 225B for supercooling performs heat exchange between the mainstream refrigerant which flows a refrigerant circuit 220, and the bypass style refrigerant which flows the bypass circuit 230. That is, in a refrigerant circuit 220, the refrigerant breathed out from the compressor 201 is condensed by the outdoor heat exchanger 203 which works as a condenser, and is supercooled by the heat exchanger 225. And it passes along a check valve 209. Then, the expansion device 211 of each indoor units B and C decompresses, and it evaporates by the indoor heat exchanger 210 which works as an evaporator, and a compressor 201 absorbs through the accumulator 208 of outdoor unit A.

[0037] Thus, by supercooling a refrigerant by heat exchanger 225B, a refrigerating effect can be increased as compared with the case where supercooling is not performed. And it sets in Ph diagram shown in drawing 2 since the boiling points of the refrigerant which constitutes the non-azeotropy mixing refrigerant which flows into indoor heat exchanger 210 differed mutually, and is inclination (inclination to a specific-enthalpy shaft.) to the constant-temperature line in a two phase region (wet steam range). It is called a "temperature gradient" below. It is generated. For the temperature gradient of this two phase region, the inlet temperature of indoor heat exchanger 210 falls as compared with the case where a single refrigerant is used. Therefore, by indoor heat exchanger 210, the temperature gradient between the indoor air by which endoergic is carried out, and the refrigerant passing through the inside of the indoor heat exchanger 210 becomes large, and the heat exchange capacity of indoor heat exchanger 210 increases. Consequently, the refrigerating capacity improvement effect by supercooling can be further raised by heat exchange capacity increase of indoor heat exchanger 210 as compared with the case where a single refrigerant is used.

[0038] In addition, while the refrigerant circuit 217,220 is performing air conditioning operation independently When it is judged that cold energy gets down from a complementary by the refrigerant circuit 220 side contrary to the upper case, and cold energy runs short by the refrigerant circuit 217 side based on the output of a pressure sensor 235,236 According to this decision result, by the control means, open condition and closing motion valve 231B is set as a closed state, and the closing motion valve 231 shifts to air conditioning operation to which a refrigerant circuit 217 carries out supercooling.

[0039]

[Effect of the Invention] As mentioned above, according to the air conditioner according to claim 1 to 3, as compared with the former, refrigerating capacity can be further raised so that clearly.

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[Translation done.]



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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is drawing showing the configuration of the refrigerant circuit of the air conditioner of the 1st operation gestalt of this invention.
[Drawing 2] It is Ph diagram showing the refrigerating cycle by the refrigerant circuit of drawing 1 .
[Drawing 3] It is drawing explaining the heat exchange capacity of the evaporator in the refrigerant circuit of drawing 1 .
[Drawing 4] Drawing in which (a) shows the configuration of the double pipe exchanger of the refrigerant circuit of drawing 1 , drawing where (b) explains the coolant temperature in a counterflow mold heat exchanger, and (c) are drawings explaining the coolant temperature in a parallel-current-flow mold heat exchanger.
[Drawing 5] It is drawing showing the configuration of the refrigerant circuit which uses a double pipe exchanger as a mind-solution temperature exchanger for the comparison with the refrigerant circuit of drawing 1 .
[Drawing 6] It is Ph diagram showing the refrigerating cycle by the refrigerant circuit of drawing 5 .
[Drawing 7] It is drawing measuring and showing the refrigerating cycle by the refrigerant circuit of drawing 1 , and the refrigerating cycle by the refrigerant circuit of drawing 5 .
[Drawing 8] It is drawing showing the configuration of the refrigerant circuit of the air conditioner of the 2nd operation gestalt of this invention.
[Drawing 9] It is drawing showing the configuration of the refrigerant circuit of the air conditioner of the 3rd operation gestalt of this invention.
[Drawing 10] It is drawing showing the configuration of the refrigerant circuit of the conventional air conditioner.
[Drawing 11] They are Ph diagram showing the usual refrigerating cycle to which (a) does not perform supercooling, Ph diagram showing the refrigerating cycle according [ (b) ] to the refrigerant circuit of drawing 11 , and drawing which (c) expands the refrigerating cycle of (b) partially and is shown.
[Description of Notations]
2,102,201 Compressor
3 Condenser
5 Evaporator
10 Double Pipe Exchanger
103,203 Outdoor heat exchanger
105,210 Indoor heat exchanger
110 Heat Exchanger for Accumulation
225,225B Heat exchanger for supercooling

[Translation done.]

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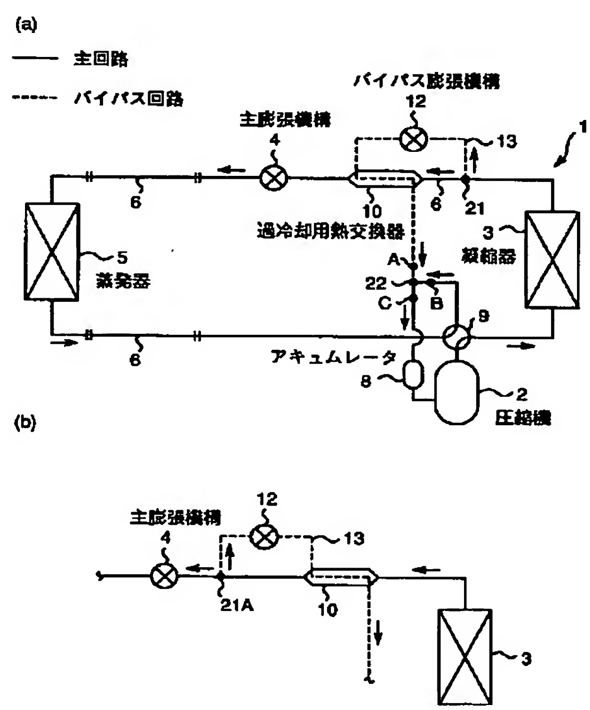
最終頁に続く

(54)【発明の名称】　空気調和機

(57)【要約】
【課題】　従来よりも冷凍能力を向上できる空気調和機を提供する。
【解決手段】　圧縮機２、凝縮器３、過冷却用熱交換器１０、第１の膨張機構４および蒸発器５の順に冷媒が流れる冷媒回路１を備える。冷媒として非共沸混合冷媒を用いる。冷媒回路１は、凝縮器３と第１の膨張機構４との間で主回路６から分岐して、圧縮機２の吸入側で主回路６と合流するバイパス回路１３を備えるとともに、このバイパス回路１３に第２の膨張機構１２を有する。過冷却用熱交換器１０は、主回路６を流れる主流冷媒と、第２の膨張機構１２通過後のバイパス回路１３を流れるバイパス流冷媒との間で熱交換を行う。過冷却用熱交換器１０は、上記主流冷媒と上記バイパス流冷媒とが伝熱性を持つ壁１０ａを挟んで互いに反対向きに流れる対向流型熱交換器である。



【特許請求の範囲】

【請求項１】　圧縮機（２）、凝縮器（３）、過冷却用熱交換器（１０）、第１の膨張機構（４）および蒸発器（５）の順に冷媒が流れる冷媒回路（１）を備えた空気調和機において、

上記冷媒として非共沸混合冷媒を用い、

上記冷媒回路（１）は、上記凝縮器（３）と第１の膨張機構（４）との間で主回路（６）から分岐して、上記圧縮機（２）の吸入側で上記主回路（６）と合流するバイパス回路（１３）を備えるとともに、このバイパス回路（１３）に第２の膨張機構（１２）を有し、

上記過冷却用熱交換器（１０）は、上記主回路（６）を流れる主流冷媒と、上記第２の膨張機構（１２）通過後の上記バイパス回路（１３）を流れるバイパス流冷媒との間で熱交換を行い、

上記過冷却用熱交換器（１０）は、上記主流冷媒と上記バイパス流冷媒とが伝熱性を持つ壁（１０ａ）を挟んで互いに反対向きに流れる対向流型熱交換器であることを特徴とする空気調和機。

【請求項２】　請求項１に記載の空気調和機において、上記バイパス回路（１３）は、上記凝縮器（３）と過冷却用熱交換器（１０）との間で上記主回路（６）から分岐していることを特徴とする空気調和機。

【請求項３】　請求項１に記載の空気調和機において、上記バイパス回路（１３）は、上記過冷却用熱交換器（１０）と第１の膨張機構（４）との間で上記主回路（６）から分岐していることを特徴とする空気調和機。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】この発明は空気調和機に関する。より詳しくは、圧縮機、凝縮器、冷媒を過冷却する過冷却用熱交換器、膨張機構および蒸発器の順に冷媒を循環させる冷媒回路を備えた空気調和機に関する。

【０００２】

【従来の技術】図１０に示すように、この種の空気調和機の冷媒回路３０１としては、圧縮機３０２、凝縮器３０３、過冷却用の二重管式熱交換器３１０、主膨張機構３０４、蒸発器３０５、四路切換弁３０９およびアキュムレータ３０８をこの順に有する主回路３０６と、上記凝縮器３０３と二重管式熱交換器３１０との間の分岐点３２１で主回路３０６から分岐して、バイパス膨張機構３１２と二重管式熱交換器３１０とを通り、上記アキュムレータ３０８の入口近傍の合流点３２２で主回路３０６と合流するバイパス回路（破線で示す）３１３とを含むものが知られている。従来は、冷媒としてＨＣＦＣ（ハイドロクロロフルオロカーボン）２２等の単一冷媒が用いられている。圧縮機３０２から吐出された冷媒は、凝縮器（例えば室外空気に放熱する）３０３によって凝縮され、分岐点３２１で主回路３０６を流れる主流冷媒とバイパス回路３１３を流れるバイパス流冷媒とに別れる。この主流冷媒は、二重管式熱交換器３１０において、バイパス膨張機構３１２通過後の上記バイパス流冷媒との熱交換によって過冷却された後、主膨張機構３０４によって減圧される。そして、主流冷媒は、蒸発器（例えば室内空気から吸熱する）３０５によって蒸発され、四路切換弁３０９および気液分離を行うアキュムレータ３０８を通して圧縮機３０２に吸い込まれる。一方、バイパス流冷媒は、上記バイパス膨張機構３１２を通過して減圧された後、二重管式熱交換器３１０において主流冷媒との熱交換によって蒸発される。この後、バイパス流冷媒は、アキュムレータ３０８の入口近傍の合流点３２２で主流冷媒と合流する。

【０００３】このように二重管式熱交換器３１０で主流冷媒を過冷却することにより、過冷却を行わない場合に比して主流冷媒による冷凍効果を増大できる。また、冷媒の流れからバイパス流を分岐させることによって主流冷媒の体積流量が減少するので、図１１(b)の圧力－比エンタルピ線図（以下「Ｐｈ線図」という。）に示すように、蒸発器３０５内および圧縮機３０２の吸入側配管での圧力損失ΔＰを減少させることができる（比較のため、過冷却を行わない場合の圧力損失ΔＰ0を図１１(a)に示している。）。したがって、システムの冷凍能力を向上させることができる。なお、図１１(b)中にＡ，Ｂ，Ｃで示す箇所は、図１０の冷媒回路３０１における合流点３２２近傍の点Ａ，Ｂ，Ｃの状態に対応している。図１１(b)を部分的に拡大して示す図１１(c)によって良く分かるように、点Ａに達したバイパス流冷媒と点Ｂに達した主流冷媒とが合流して、点Ｃの状態が得られる。

【０００４】

【発明が解決しようとする課題】ところで、空気調和機の冷凍能力は常に向上させることが求められており、冷凍能力アップの要求に際限はない。

【０００５】そこで、この発明の目的は、従来よりもさらに冷凍能力を向上させることができる空気調和機を提供することにある。

【０００６】

【課題を解決するための手段】上記目的を達成するため、請求項１に記載の空気調和機は、圧縮機、凝縮器、過冷却用熱交換器、第１の膨張機構および蒸発器の順に冷媒が流れる冷媒回路を備えた空気調和機において、上記冷媒として非共沸混合冷媒を用い、上記冷媒回路は、上記凝縮器と第１の膨張機構との間で主回路から分岐して、上記圧縮機の吸入側で上記主回路と合流するバイパス回路を備えるとともに、このバイパス回路に第２の膨張機構を有し、上記過冷却用熱交換器は、上記主回路を流れる主流冷媒と、上記第２の膨張機構通過後の上記バイパス回路を流れるバイパス流冷媒との間で熱交換を行い、上記過冷却用熱交換器は、上記主流冷媒と上記バイパス流冷媒とが伝熱性を持つ壁を挟んで互いに反対向き

に流れる対向流型熱交換器であることを特徴とする。

【０００７】この請求項１の空気調和機では、非共沸混合冷媒を構成する冷媒の沸点が互いに異なることから、冷媒の状態を表すＰｈ線図において、二相域（湿り蒸気範囲）で等温線に勾配（比エンタルピ軸に対する傾き。以下「温度勾配」という。）が生じる。この二相域の温度勾配のために、単一冷媒を用いる場合に比して、蒸発器の入口温度が低下する。したがって、蒸発器によって吸熱される流体（例えば室内空気）と、その蒸発器内を通る上記冷媒との間の温度差が大きくなって、蒸発器の熱交換能力が増大する。この結果、過冷却による冷凍能力改善効果は、単一冷媒を用いる場合に比して、上記蒸発器の熱交換能力増大分だけさらに向上する。

【０００８】また、この空気調和機では、上記第２の膨張機構通過後のバイパス流冷媒を利用して、簡単な回路構成でもって主流冷媒を過冷却することができる。

【０００９】さらに、この空気調和機では、上記過冷却用熱交換器は対向流型熱交換器であるから、過冷却用熱交換器の伝熱性を持つ壁の両側での、非共沸冷媒である主流冷媒とバイパス流冷媒との間の平均温度差が比較的大きくなる。例えば並行流型熱交換器の場合の平均温度差よりも大きくなる。この結果、過冷却用熱交換器の能力が向上する。

【００１０】請求項２に記載の空気調和機は、請求項１に記載の空気調和機において、上記バイパス回路は、上記凝縮器と過冷却用熱交換器との間で上記主回路から分岐していることを特徴とする。

【００１１】この請求項２の空気調和機では、過冷却用熱交換器によって過冷却される対象が主流冷媒だけとなるので、過冷却用熱交換器のサイズが比較的小さくて済む。

【００１２】請求項３に記載の空気調和機は、請求項１に記載の空気調和機において、上記バイパス回路は、上記過冷却用熱交換器と第１の膨張機構との間で上記主回路から分岐していることを特徴とする。

【００１３】この請求項３の空気調和機では、過冷却用熱交換器通過後に主流冷媒から分岐したバイパス流冷媒が第２の膨張機構に入るので、第２の膨張機構には二相流が入る可能性が少なくなる。したがって、第２の膨張機構はハンチングを起こすおそれがなく、安定に動作する。

【００１４】

【発明の実施の形態】以下、この発明の実施の形態を詳細に説明する。

【００１５】（第１実施形態）図１(a)に示すように、この発明の一実施形態の空気調和機は、主回路６とバイパス回路（破線で示す）１３とを含む冷媒回路１を備えている。冷媒回路１を循環させる冷媒としては、Ｒ－３２／１３４ａまたはＲ－４０７Ｃからなる非共沸混合冷媒を用いている。



【００１６】主回路６は、圧縮機２、凝縮器３、過冷却用熱交換器としての二重管式熱交換器１０、第１の膨張機構としての主膨張機構４、蒸発器５、四路切換弁９およびアキュムレータ８をこの順に有している。バイパス回路１３は、凝縮器３と二重管式熱交換器１０との間の分岐点２１で主回路６から分岐して、第２の膨張機構としてのバイパス膨張機構１２と二重管式熱交換器１０とを通り、アキュムレータ８の入口近傍の合流点２２で主回路６と合流している。二重管式熱交換器１０は、主回路６を流れる主流冷媒と、バイパス膨張機構１２通過後の上記バイパス回路１３を流れるバイパス流冷媒との間で熱交換を行う。つまり、バイパス膨張機構１２通過後のバイパス流冷媒を利用して、簡単な回路構成でもって主流冷媒を過冷却するようになっている。詳しくは、二重管式熱交換器１０は、図４(a)に模式的に示すように、内管１０ａと、この内管１０ａの外側に同心円状に設けられた外管１０ｂとを有している。冷媒を流す向きは、内管１０ａ内を流れるバイパス流冷媒と、内管１０ａと外管１０ｂとの間の環状の隙間１０ｃを流れる主流冷媒とが、伝熱性を持つ内管１０ａの管壁を挟んで互いに反対向きに流れるように設定されている（対向流型熱交換器）。このように熱交換器１０を対向流型とした場合、図４(b)に示すように、伝熱性を持つ内管１０ａの管壁の両側での、主流冷媒とバイパス流冷媒との間の流れ方向に関する平均温度差が比較的大きくなる。例えば図４(c)に示す並行流型熱交換器の場合の平均温度差よりも大きくなる。この結果、熱交換器１０の能力を向上させることができる。

【００１７】さて、図１(a)に示す圧縮機２から吐出された冷媒は、凝縮器（例えば室外空気に放熱する）３によって凝縮され、分岐点２１で主回路６を流れる主流冷媒とバイパス回路１３を流れるバイパス流冷媒とに別れる。この主流冷媒は、熱交換器１０において、バイパス膨張機構１２通過後の上記バイパス流冷媒との熱交換によって過冷却された後、主膨張機構４によって減圧される。そして、主流冷媒は、蒸発器（例えば室内空気から吸熱する）５によって蒸発され、四路切換弁９および気液分離を行うアキュムレータ８を通して圧縮機２に吸い込まれる。一方、バイパス流冷媒は、バイパス膨張機構１２を通過して減圧された後、熱交換器１０において主流冷媒との熱交換によって蒸発される。この後、バイパス流冷媒は、アキュムレータ８の入口近傍の合流点２２で主流冷媒と合流する。

【００１８】このように熱交換器１０で主流冷媒を過冷却することにより、過冷却を行わない場合に比して主流冷媒による冷凍効果を増大できる。また、冷媒の流れからバイパス流を分岐させることによって主流冷媒の体積流量が減少するので、過冷却を行わない場合（図１１(a)参照）に比して、図２の圧力－比エンタルピ線図（以下「Ｐｈ線図」という。）に示すように、蒸発器５

内および圧縮機２の吸入側配管での圧力損失ΔＰを減少させることができる。したがって、システムの冷凍能力を向上させることができる。なお、図２中にＡ，Ｂ，Ｃで示す箇所は、図１(a)の冷媒回路１における合流点２２近傍の点Ａ，Ｂ，Ｃの状態に対応している。

【００１９】しかも、冷媒回路１を流れる非共沸混合冷媒を構成する冷媒の沸点が互いに異なることから、図２に示すＰｈ線図において、二相域（湿り蒸気範囲）で等温線に勾配（比エンタルピ軸に対する傾き。以下「温度勾配」という。）が生じる。この二相域の温度勾配のために、単一冷媒を用いる場合に比して、蒸発器５の入口温度が低下する。したがって、蒸発器５によって吸熱される流体（例えば蒸発器のフィンに接して通る室内空気）と、その蒸発器５内を通る冷媒との間の温度差が大きくなって、蒸発器５の熱交換能力が増大する。例えば図３に示すように、蒸発器５の入口温度が２ｄｅｇだけ低下すると、蒸発器５の熱交換能力が約１５％増大する。この結果、過冷却による冷凍能力改善効果を、単一冷媒を用いる場合に比して、蒸発器５の熱交換能力増大分だけさらに向上させることができる。

【００２０】また、図１(a)に示すように、バイパス回路１３は凝縮器３と熱交換器１０との間で主回路６から分岐しているので、熱交換器１０によって過冷却される対象が主流冷媒だけとなる。したがって、熱交換器１０のサイズを比較的小さくすることができる。

【００２１】なお、バイパス回路１３は、図１(b)に示すように、熱交換器１０と主膨張機構４との間（分岐点２１Ａ）で主回路６から分岐するようにしても良い。このようにした場合、熱交換器１０を通過後に主流冷媒から分岐したバイパス流冷媒がバイパス膨張機構１２に入るので、バイパス膨張機構１２には二相流が入る可能性が少なくなる。したがって、バイパス膨張機構１２はハンチングを起こすおそれがなく、安定に動作する。

【００２２】上述のように、熱交換器１０は、凝縮器３によって凝縮された状態の、主回路６を流れる主流冷媒と、バイパス膨張機構１２通過後のバイパス流冷媒との間で熱交換を行っている。すなわち、熱交換器１０は、基本的には、凝縮器３通過後、蒸発器５通過前の主流冷媒とバイパス流冷媒との間で熱交換を行う液－液熱交換器として動作している。これに対して、図５に示すように、凝縮器５通過後の主流冷媒を過冷却するために、蒸発器５通過後（圧縮機吸入側）の気相の主流冷媒を用いて、熱交換器１０を気－液熱交換器として動作させても良い。ただし、図１に示したような熱交換器１０を液－液熱交換器として動作させる場合は、図７(a)のＰｈ線図に示すように、二相域における温度勾配に起因して、熱交換器１０における流れ方向に関する平均温度差ΔＴｍが、気－液熱交換器として動作させる場合のΔＴｍ（図７(b)に示す）よりも大きくなる。したがって、熱交換器１０のサイズを比較的小さくすることができ、圧縮機２の吸入側の過熱度が大きくなるような不具合（図６参照）が生じない。この結果、非共沸混合冷媒を使用することによる冷凍能力改善効果をより有効に発揮することができる。

【００２３】（第２実施形態）図８は、氷に蓄えられた冷熱を用いて冷媒を過冷却する冷媒回路１０１を備えた別の実施形態の空気調和機を示している。この冷媒回路１０１は、主回路１０６と短絡回路１１３とを含む冷媒回路１０１を備えている。冷媒回路１０１を循環させる冷媒としては、Ｒ－３２／１３４ａまたはＲ－４０７Ｃからなる非共沸混合冷媒を用いている。

【００２４】主回路１０６は、圧縮機１０２、凝縮器としての室外熱交換器１０３、冷媒を一時貯留するためのレシーバ１０７、第２電子膨張弁１１２、第１の膨張機構としての第１電子膨張弁１０４、蒸発器としての室内熱交換器１０５、アキュムレータ１０８をこの順に有している。第２電子膨張弁１１２には並列に、過冷却用熱交換器としての蓄熱用熱交換器１１０の室外側連結端１１０ｂ，室内側連結端１１０ｃが接続されている。蓄熱用熱交換器１１０は、蓄熱媒体としての水Ｗを満たした蓄熱槽１０９内に、鉛直方向に蛇行する冷却管１０ａを設けて形成されている。蓄熱用熱交換器１１０の本体１０９と室外側連結端１１０ｂとの間の配管には第１開閉弁１１１が介挿されている。短絡回路１１３は、蓄熱用熱交換器１１０の本体１０９と第１開閉弁１１１との間から分岐して、アキュムレータ８の入口近傍で主回路１０６と合流している。この短絡回路１１３には第２開閉弁１１４が介挿されている。第１開閉弁１１１および第２開閉弁１１４の開閉、第１電子膨張弁１０４および第２電子膨張弁１１２の開度は、この空気調和機の運転状態および各サーミスタＴｈ１，Ｔｈ２、圧力センサＰｓからの信号に応じて、開閉制御手段１１６によって制御されるようになっている。

【００２５】蓄熱運転時には、開閉制御手段１１６によって、第１開閉弁１１１が閉状態、第２開閉弁１１４が開状態、第１電子膨張弁１０４が全閉状態にされるとともに、第２電子膨張弁１１２の開度がサーミスタＴｈ１、圧力センサＰｓからの信号に応じて制御される。このとき、圧縮機１０２から吐出された冷媒（流れの向きを図８中に実線の矢印で示す）は、室外熱交換器１０３によって凝縮され、レシーバ１０７、第２電子膨張弁１１２を通り、蓄熱用熱交換器１１０において上記水Ｗとの熱交換によって蒸発された後、短絡回路１１３の第２開閉弁１１４を通り、主回路１０６のアキュムレータ８を通して圧縮機２に吸い込まれる。蓄熱槽１０９内の水Ｗは、冷却管１１０ａを通る冷媒との熱交換によって冷却されて、冷却管１１０ａの表面に氷として付着する。これにより、蓄熱槽１０９に冷熱が蓄えられる。

【００２６】蓄熱回収を行う冷房運転時には、開閉制御手段１１６によって、第１開閉弁１１１が開状態、第２

開閉弁１１４が閉状態、第１電子膨張弁１０４および第２電子膨張弁１１２の開度がサーミスタＴｈ２、圧力センサＰｓからの信号に応じて制御される。このとき、圧縮機１０２から吐出された冷媒（流れの向きを図８中に破線の矢印で示す）は、室外熱交換器１０３によって凝縮され、レシーバ１０７を通る。この後、冷媒の一部は第２電子膨張弁１１２を通り、そのまま合流点１１０ｃに達するが、残りの冷媒は、分岐点１１０ｂから第１開閉弁１１１を通り、蓄熱用熱交換器１１０において蓄熱運転時に生成された氷との熱交換によって過冷却された後、合流点１１０ｃに達する。このとき、第２電子膨張弁１１２を通る冷媒と蓄熱用熱交換器１１０を通る冷媒との流量比は第２電子膨張弁１１２の開度によって定まる。蓄熱用熱交換器１１０は、氷に蓄えられた冷熱を用いて上記冷媒を過冷却するので、冷却管１１０ａを通る冷媒を効果的に過冷却することができる。合流点１１０ｃで合流した冷媒は、第１電子膨張弁１０４によって減圧された後、室内熱交換器１０５において室内空気との熱交換によって蒸発され、アキュムレータ８を通して圧縮機２に吸い込まれる。

【００２７】このように蓄熱用熱交換器１１０で冷媒を過冷却することにより、過冷却を行わない場合に比して冷凍効果を増大できる。しかも、室内熱交換器１０５に流入する非共沸混合冷媒を構成する冷媒の沸点が互いに異なることから、図２に示したＰｈ線図において、二相域（湿り蒸気範囲）で等温線に勾配（比エンタルピ軸に対する傾き。以下「温度勾配」という。）が生じる。この二相域の温度勾配のために、単一冷媒を用いる場合に比して、室内熱交換器１０５の入口温度が低下する。したがって、室内熱交換器１０５によって吸熱される室内空気と、その室内熱交換器１０５内を通る冷媒との間の温度差が大きくなって、室内熱交換器１０５の熱交換能力が増大する。この結果、過冷却による冷凍能力改善効果を、単一冷媒を用いる場合に比して、室内熱交換器１０５の熱交換能力増大分だけさらに向上させることができる。

【００２８】なお、蓄熱回収を行わない通常の冷房運転を行うためには、開閉制御手段１１６によって、第１開閉弁１１１および第２開閉弁１１４を閉状態、第２電子膨張弁１１２を全開状態にし、第１電子膨張弁１０４の開度をサーミスタＴｈ２、圧力センサＰｓからの信号に応じて制御すれば良い。このとき、圧縮機１０２から吐出された冷媒は、室外熱交換器１０３によって凝縮され、レシーバ１０７、第２電子膨張弁１１２を通り、室内熱交換器１０５によって蒸発され、アキュムレータ１０８を通して圧縮機１０２に吸い込まれる。

【００２９】（第３実施形態）図９は、別の冷媒回路から供給される冷熱を用いて冷媒を過冷却する冷媒回路を備えた別の実施形態の空気調和機を示している。

【００３０】この空気調和機は、同一構成の２つの機器類Ｈ，Ｉを含む１台の室外ユニットＡと、この室外ユニットＡの一方の機器類Ｈに接続された２台の室内ユニットＢ，Ｃと、室内ユニットＡの他方の機器類Ｉに接続された２台の室内ユニットＤ，Ｅを備えている。



【００３１】室外ユニットＡの一方の機器類Ｈは、アキュムレータ２０８と、インバータ２０７によって駆動される圧縮機２０１と、四路切換弁２０２と、室外熱交換器２０３と、過冷却用熱交換器２２５と、冷房運転時に冷媒を一方向（図中に実線の矢印で示す向き）にのみ通過させる逆止弁２０９と、この逆止弁２０９に並列に接続された暖房運転用の膨張機構２０４とを冷媒配管２０５で接続したものである。同様に、他方の機器類Ｉは、アキュムレータ２０８と、インバータ２０７によって駆動される圧縮機２０１と、四路切換弁２０２と、室外熱交換器２０３と、過冷却用熱交換器２２５Ｂと、冷房運転時に冷媒を一方向にのみ通過させる逆止弁２０９と、この逆止弁２０９に並列に接続された暖房運転用の膨張機構２０４とを冷媒配管２０５で接続したものである。各室内ユニットＢ，Ｃ，Ｄ，Ｅは同一内部構成であり、それぞれ室内熱交換器２１０と、暖房運転時に冷媒を冷房運転時とは逆方向にのみ通過させる逆止弁２１３と、この逆止弁２１３に並列に接続された冷房運転用の膨張機構２１１とを冷媒配管２１２で接続したものである。なお、以下では冷房運転に関して説明するものとする。

【００３２】室内ユニットＢ，Ｃは冷媒配管２１５，２１５で互いに並列に接続されつつ、他の冷媒配管２１６，２１６により室外ユニットＡの一方の機器類Ｈに冷媒の循環可能に接続されて一つの冷媒回路２１７が形成されている。同様に、室内ユニットＣ，Ｄは冷媒配管２１８，２１８で互いに並列に接続されつつ、他の冷媒配管２１９，２１９により室外ユニットＡの他方の機器類Ｉに冷媒の循環可能に接続されて別の冷媒回路２２０が形成されている。各冷媒回路２１７，２２０の圧縮機２０１の吸入側（室外ユニットＡの冷媒入口近傍）には、それぞれその冷媒回路の運転状態を検出するための圧力センサ２３５，２３６が設けられている。

【００３３】これらの冷媒回路２１７，２２０を循環させる冷媒としては、Ｒ－３２／１３４ａまたはＲ－４０７Ｃからなる非共沸混合冷媒を用いている。

【００３４】機器類Ｈ側の冷媒回路２１７と機器類Ｉ側の冷媒回路２２０との間には、バイパス回路２３０，２３０Ｂが設けられている。バイパス回路２３０（冷媒配管２２７，２２８を有する）は、冷媒回路２２０の室外熱交換器２０３の下流側（冷房運転時の出口近傍）から分岐して、開閉弁２３１、膨張機構２２６、冷媒回路２１７の過冷却用熱交換器２２５を通り、冷媒回路２２０のアキュムレータ２０８の入口近傍でその冷媒回路２２０と合流している。バイパス回路２３０Ｂ（冷媒配管２２７Ｂ，２２８Ｂを有する）は、冷媒回路２１７の室外熱交換器２０３の下流側（冷房運転時の出口近傍）から

分岐して、開閉弁２３１Ｂ、膨張機構２２６Ｂ、冷媒回路２２０の過冷却用熱交換器２２５Ｂを通り、冷媒回路２１７のアキュムレータ２０８の入口近傍でその冷媒回路２１７と合流している。過冷却用熱交換器２２５は、例えば図４(a)に示した二重管式熱交換器１０と同様に構成され、冷媒回路２１７を流れる主流冷媒と、冷媒回路２２０から分岐したバイパス回路２３０を流れるバイパス流冷媒との間で熱交換を行う。一方、過冷却熱交換器２２５Ｂは、冷媒回路２２０を流れる主流冷媒と、冷媒回路２１７から分岐したバイパス回路２３０Ｂを流れるバイパス流冷媒との間で熱交換を行う。

【００３５】過冷却を行わない通常の冷房運転時には、図示しない制御手段によってバイパス回路２３０，２３０Ｂの開閉弁２３１および２３１Ｂが閉状態にされる。このとき、冷媒回路２１７と冷媒回路２２０とは互いに独立に冷房運転を行う。例えば冷媒回路２２０において、圧縮機２０１から吐出された冷媒（流れの向きを図９中に実線の矢印で示す）は、凝縮器として働く室外熱交換器２０３によって凝縮され、熱交換を行わない状態にある熱交換器２２５Ｂ、逆止弁２０９を通っる。この後、各室内ユニットＢ，Ｃの膨張機構２１１によって減圧され、蒸発器として働く室内熱交換器２１０によって蒸発され、そして室外ユニットＡのアキュムレータ２０８を通して圧縮機２０１に吸い込まれる。これは冷媒回路２１７においても同様である。

【００３６】冷媒回路２１７，２２０が独立に冷房運転を行っている時に、圧力センサ２３５，２３６の出力に基づいて、例えば冷媒回路２１７側で冷熱が余っており、冷媒回路２２０側で冷熱が不足していると判断されたとする。この判断結果に応じて、制御手段によって、開閉弁２３１が閉状態、開閉弁２３１Ｂが開状態に設定され、冷媒回路２２０が過冷却を行う冷房運転に移行する。このとき、冷媒回路２１７を流れる冷媒の一部が分岐して、バイパス流冷媒（流れの向きを図９中に破線の矢印で示す）としてバイパス回路２３０Ｂを流れる。この結果、過冷却用熱交換器２２５Ｂは、冷媒回路２２０を流れる主流冷媒と、バイパス回路２３０を流れるバイパス流冷媒との間で熱交換を行う。つまり、冷媒回路２２０において、圧縮機２０１から吐出された冷媒は、凝縮器として働く室外熱交換器２０３によって凝縮され、熱交換器２２５によって過冷却される。それから、逆止弁２０９を通る。この後、各室内ユニットＢ，Ｃの膨張機構２１１によって減圧され、蒸発器として働く室内熱交換器２１０によって蒸発され、そして室外ユニットＡのアキュムレータ２０８を通して圧縮機２０１に吸い込まれる。

【００３７】このように熱交換器２２５Ｂで冷媒を過冷却することにより、過冷却を行わない場合に比して冷凍効果を増大できる。しかも、室内熱交換器２１０に流入する非共沸混合冷媒を構成する冷媒の沸点が互いに異なることから、図２に示したＰｈ線図において、二相域（湿り蒸気範囲）で等温線に勾配（比エンタルピ軸に対する傾き。以下「温度勾配」という。）が生じる。この二相域の温度勾配のために、単一冷媒を用いる場合に比して、室内熱交換器２１０の入口温度が低下する。したがって、室内熱交換器２１０によって吸熱される室内空気と、その室内熱交換器２１０内を通る冷媒との間の温度差が大きくなって、室内熱交換器２１０の熱交換能力が増大する。この結果、過冷却による冷凍能力改善効果を、単一冷媒を用いる場合に比して、室内熱交換器２１０の熱交換能力増大分だけさらに向上させることができる。

【００３８】なお、冷媒回路２１７，２２０が独立に冷房運転を行っている時に、圧力センサ２３５，２３６の出力に基づいて、上の場合とは逆に冷媒回路２２０側で冷熱が余っており、冷媒回路２１７側で冷熱が不足していると判断された場合は、この判断結果に応じて、制御手段によって、開閉弁２３１が開状態、開閉弁２３１Ｂが閉状態に設定され、冷媒回路２１７が過冷却を行う冷房運転に移行する。

【００３９】

【発明の効果】以上より明らかなように、請求項１乃至３に記載の空気調和機によれば、従来に比してさらに冷凍能力を向上させることができる。

【図面の簡単な説明】

【図１】　この発明の第１実施形態の空気調和機の冷媒回路の構成を示す図である。

【図２】　図１の冷媒回路による冷凍サイクルを示すＰｈ線図である。

【図３】　図１の冷媒回路における蒸発器の熱交換能力を説明する図である。

【図４】　(a)は図１の冷媒回路の二重管式熱交換器の構成を示す図、(b)は対向流型熱交換器における冷媒温度を説明する図、(c)は並行流型熱交換器における冷媒温度を説明する図である。

【図５】　図１の冷媒回路との比較のために、二重管式熱交換器を気－液熱交換器として用いる冷媒回路の構成を示す図である。

【図６】　図５の冷媒回路による冷凍サイクルを示すＰｈ線図である。

【図７】　図１の冷媒回路による冷凍サイクルと図５の冷媒回路による冷凍サイクルとを比較して示す図である。

【図８】　この発明の第２実施形態の空気調和機の冷媒回路の構成を示す図である。

【図９】　この発明の第３実施形態の空気調和機の冷媒回路の構成を示す図である。

【図１０】　従来の空気調和機の冷媒回路の構成を示す図である。

【図１１】　(a)は過冷却を行わない通常の冷凍サイク

ルを示すＰｈ線図、(b)は図１１の冷媒回路による冷凍サイクルを示すＰｈ線図、(c)は(b)の冷凍サイクルを部分的に拡大して示す図である。

【符号の説明】

２，１０２，２０１　圧縮機

３　凝縮器　＊

＊５　蒸発器

１０　二重管式熱交換器

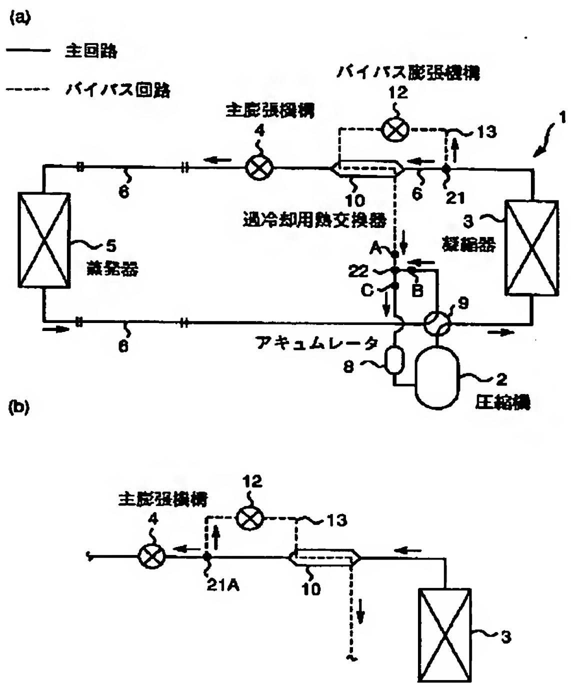
１０３，２０３　室外熱交換器

１０５，２１０　室内熱交換器

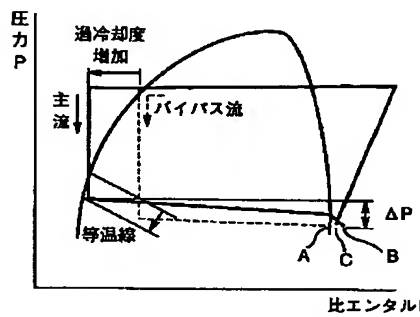
１１０　蓄熱用熱交換器

２２５，２２５Ｂ　過冷却用熱交換器

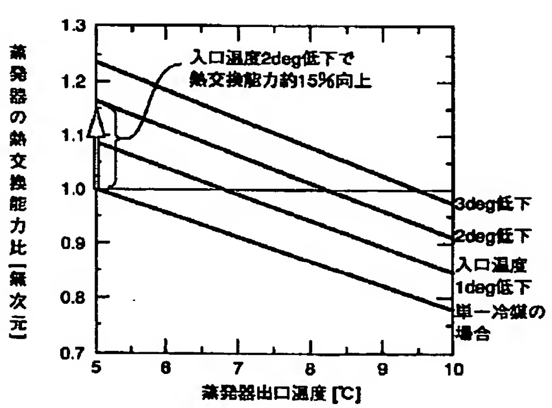
【図１】



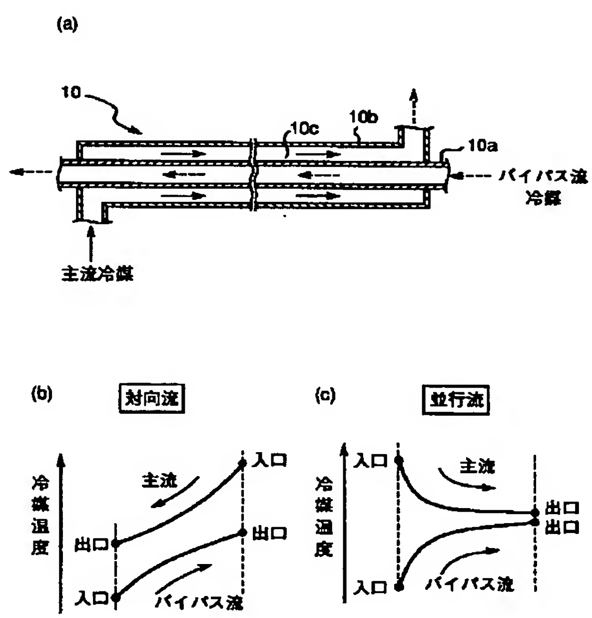

【図２】



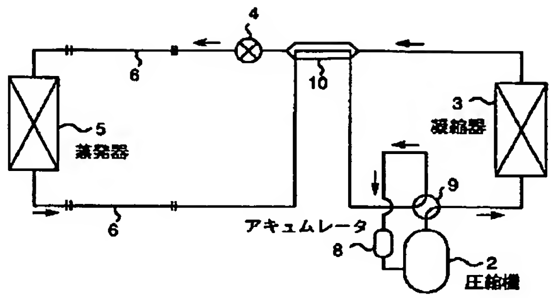

【図３】



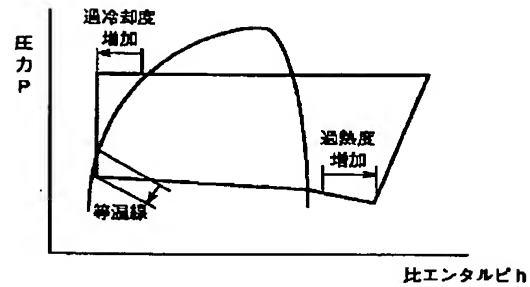

【図４】



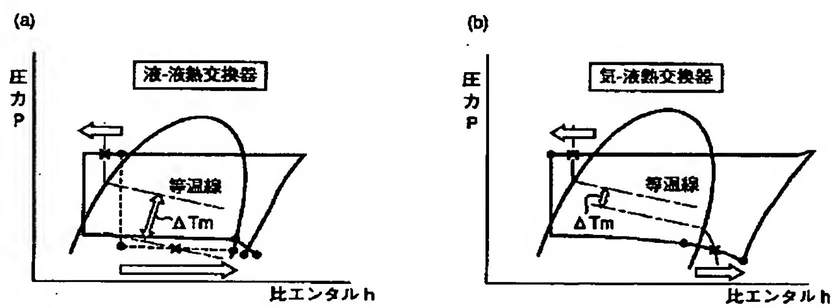
【図５】


4
6
10
3
凝縮器
5
蒸発器
9
6
アキュムレータ
8
2
圧縮機

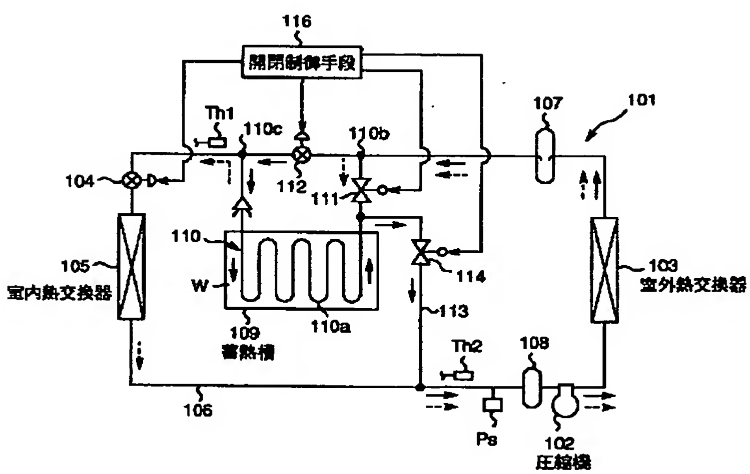
【図６】


圧力P
過冷却度増加
過熱度増加
等温線
比エンタルピh

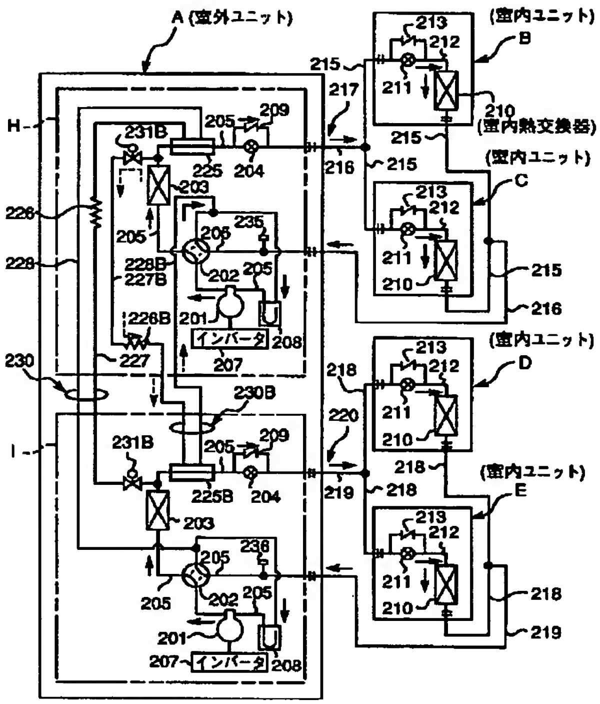
【図７】


(a)
圧力P
液-液熱交換器
等温線
ΔTm
比エンタルh
(b)
圧力P
気-液熱交換器
等温線
ΔTm
比エンタルh

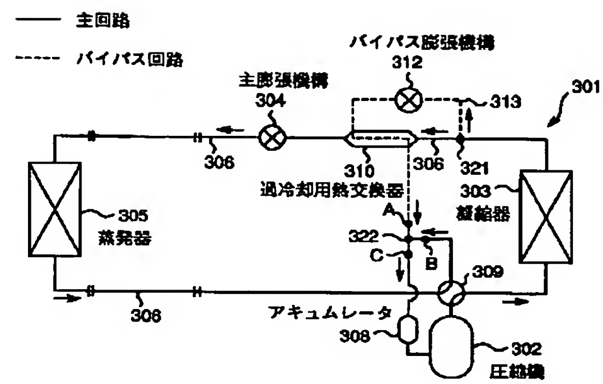
【図８】


116
開閉制御手段
Th1
110c
110b
107
101
104
112
111
110
105
室内熱交換器
W
114
113
103
室外熱交換器
109
蓄熱槽
110a
Th2
108
106
Ps
102
圧縮機

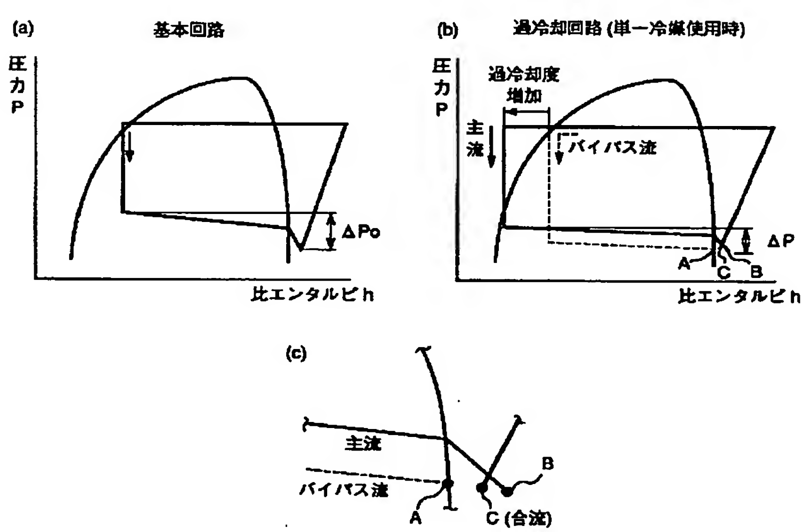
【図９】



【図１０】




【図１１】

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